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Three-charge-particle systems in the framework of coupled coordinate-space few-body equations

We study three-charge-particle low-energy elastic collision and particle-exchange reaction with special attention to the systems with Coulomb and an additional nuclear interaction employing a close-coupling expansion scheme to a set of coupled two-component few-body equations [1,2]. First we apply our formulation to compute low-energy elastic scattering phase shifts for the d+$(t\mu^-)_{1s}$ collision, which is of significant interest for the muon-catalyzed-fusion D-T cycle. Next, we study the particle-exchange reaction d+$(pX^-)\rightarrow$ p+(dX^-) with the long-lived elementary heavy lepton stau X^-, which can play a critical role in the understanding of the Big-Bang nucleosynthesis and the nature of dark matter. We also study the total cross sections and rates for two particle-exchange reactions involving deuteron (d), triton (t), and antiprotons (p^-) e.g., $p^- + (d\mu^-)_{1s} \rightarrow (pd)_{1s} + \mu^-$ and $p^- + (t\mu^-)_{1s} \rightarrow (p^-t)_{1s} + \mu^-$, where μ^- is a muon. The effect of the final state short-range strong (p^-d) and (p^-t) nuclear interactions is significant in these reactions, which increases the reaction rates by a factor of $\sim$3.

1. R. A. Sultanov and S. K. Adhikari, EPJ Web of Conferences 262, 01023 (2022).
2. R. A. Sultanov, D. Guster, and S. K. Adhikari, Atoms 6(2), 18 (2018) (doi.org/10.3390/atoms6020018).

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